

DIMENSIONLESS NUMBERS OF FLUID MECHANICS¹²

Name(s)	Symbol	Definition	Significance
Alfvén, Kármán	Al, Ka	V_A/V	$*(\text{Magnetic force}/\text{inertial force})^{1/2}$
Bond	Bd	$(\rho' - \rho)L^2g/\Sigma$	Gravitational force/surface tension
Boussinesq	B	$V/(2gR)^{1/2}$	(Inertial force/gravitational force) ^{1/2}
Brinkman	Br	$\mu V^2/k\Delta T$	Viscous heat/conducted heat
Capillary	Cp	$\mu V/\Sigma$	Viscous force/surface tension
Carnot	Ca	$(T_2 - T_1)/T_2$	Theoretical Carnot cycle efficiency
Cauchy, Hooke	Cy, Hk	$\rho V^2/\Gamma = M^2$	Inertial force/compressibility force
Chandrasekhar	Ch	$B^2 L^2 / \rho \nu \eta$	Magnetic force/dissipative forces
Clausius	Cl	$LV^3 \rho / k\Delta T$	Kinetic energy flow rate/heat conduction rate
Cowling	C	$(V_A/V)^2 = Al^2$	Magnetic force/inertial force
Crispation	Cr	$\mu \kappa / \Sigma L$	Effect of diffusion/effect of surface tension
Dean	D	$D^{3/2}V/\nu(2r)^{1/2}$	Transverse flow due to curvature/longitudinal flow
[Drag coefficient]	C_D	$(\rho' - \rho)Lg / \rho' V^2$	Drag force/inertial force
Eckert	E	$V^2/c_p \Delta T$	Kinetic energy/change in thermal energy
Ekman	Ek	$(\nu/2\Omega L^2)^{1/2} = (\text{Ro}/\text{Re})^{1/2}$	(Viscous force/Coriolis force) ^{1/2}
Euler	Eu	$\Delta p / \rho V^2$	Pressure drop due to friction/dynamic pressure
Froude	Fr	$V/(gL)^{1/2}$ V/NL	$\dagger(\text{Inertial force}/\text{gravitational or buoyancy force})^{1/2}$
Gay-Lussac	Ga	$1/\beta \Delta T$	Inverse of relative change in volume during heating
Grashof	Gr	$gL^3 \beta \Delta T / \nu^2$	Buoyancy force/viscous force
[Hall coefficient]	C_H	λ/r_L	Gyrofrequency/collision frequency

*(†) Also defined as the inverse (square) of the quantity shown.

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Hartmann	H	$BL/(\mu\eta)^{1/2} = (Rm Re C)^{1/2}$	(Magnetic force/dissipative force) $^{1/2}$
Knudsen	Kn	λ/L	Hydrodynamic time/collision time
Lewis	Le	κ/\mathcal{D}	*Thermal conduction/molecular diffusion
Lorentz	Lo	V/c	Magnitude of relativistic effects
Lundquist	Lu	$\mu_0 LV_A/\eta = Al Rm$	$\mathbf{J} \times \mathbf{B}$ force/resistive magnetic diffusion force
Mach	M	V/C_S	Magnitude of compressibility effects
Magnetic Mach	Mm	$V/V_A = Al^{-1}$	(Inertial force/magnetic force) $^{1/2}$
Magnetic Reynolds	Rm	$\mu_0 LV/\eta$	Flow velocity/magnetic diffusion velocity
Newton	Nt	$F/\rho L^2 V^2$	Imposed force/inertial force
Nusselt	N	$\alpha L/k$	Total heat transfer/thermal conduction
Péclet	Pe	LV/κ	Heat convection/heat conduction
Poisseuille	Po	$D^2 \Delta p / \mu LV$	Pressure force/viscous force
Prandtl	Pr	ν/κ	Momentum diffusion/heat diffusion
Rayleigh	Ra	$g H^3 \beta \Delta T / \nu \kappa$	Buoyancy force/diffusion force
Reynolds	Re	LV/ν	Inertial force/viscous force
Richardson	Ri	$(NH/\Delta V)^2$	Buoyancy effects/vertical shear effects
Rossby	Ro	$V/2\Omega L \sin \Lambda$	Inertial force/Coriolis force
Schmidt	Sc	ν/\mathcal{D}	Momentum diffusion/molecular diffusion
Stanton	St	$\alpha/\rho c_p V$	Thermal conduction loss/heat capacity
Stefan	Sf	$\sigma LT^3/k$	Radiated heat/conducted heat
Stokes	S	$\nu/L^2 f$	Viscous damping rate/vibration frequency
Strouhal	Sr	fL/V	Vibration speed/flow velocity
Taylor	Ta	$(2\Omega L^2/\nu)^2 R^{1/2} (\Delta R)^{3/2} \cdot (\Omega/\nu)$	Centrifugal force/viscous force (Centrifugal force/viscous force) $^{1/2}$
Thring, Boltzmann	Th, Bo	$\rho c_p V / \epsilon \sigma T^3$	Convective heat transport/radiative heat transport
Weber	W	$\rho LV^2/\Sigma$	Inertial force/surface tension

Nomenclature:

B	Magnetic induction
C_s, c	Speeds of sound, light
c_p	Specific heat at constant pressure (units $\text{m}^2 \text{s}^{-2} \text{K}^{-1}$)
$D = 2R$	Pipe diameter
F	Imposed force
f	Vibration frequency
g	Gravitational acceleration
H, L	Vertical, horizontal length scales
$k = \rho c_p \kappa$	Thermal conductivity (units $\text{kg m}^{-1} \text{s}^{-2}$)
$N = (g/H)^{1/2}$	Brunt–Väisälä frequency
R	Radius of pipe or channel
r	Radius of curvature of pipe or channel
r_L	Larmor radius
T	Temperature
V	Characteristic flow velocity
$V_A = B/(\mu_0 \rho)^{1/2}$	Alfvén speed
α	Newton's-law heat coefficient, $k \frac{\partial T}{\partial x} = \alpha \Delta T$
β	Volumetric expansion coefficient, $dV/V = \beta dT$
Γ	Bulk modulus (units $\text{kg m}^{-1} \text{s}^{-2}$)
$\Delta R, \Delta V, \Delta p, \Delta T$	Imposed differences in two radii, velocities, pressures, or temperatures
ϵ	Surface emissivity
η	Electrical resistivity
κ, \mathcal{D}	Thermal, molecular diffusivities (units $\text{m}^2 \text{s}^{-1}$)
Λ	Latitude of point on earth's surface
λ	Collisional mean free path
$\mu = \rho \nu$	Viscosity
μ_0	Permeability of free space
ν	Kinematic viscosity (units $\text{m}^2 \text{s}^{-1}$)
ρ	Mass density of fluid medium
ρ'	Mass density of bubble, droplet, or moving object
Σ	Surface tension (units kg s^{-2})
σ	Stefan–Boltzmann constant
Ω	Solid-body rotational angular velocity